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*with the regards of the Author*

*C. F. Holder*

THE

PLACENTA AND GENERATIVE APPARATUS  
OF THE ELEPHANT.

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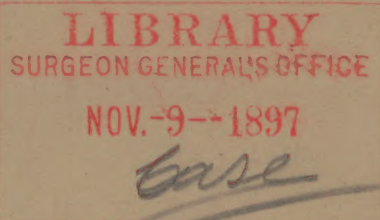
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BY

HENRY C. CHAPMAN, M.D.

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*The Placenta and Generative Apparatus of the Elephant.*

BY HENRY C. CHAPMAN, M.D.

PLACENTA.

IN January, 1879, I was requested by the late Dr. F. F. Maury to visit the Indian elephant, Hebe, forming a part of the menagerie of Cooper & Bailey's London Show, then in winter quarters at Twenty-third and Ridge Avenue, in this city. The object of the visit was to determine, if possible, whether the elephant was pregnant. At my suggestion, Drs. Leidy, Penrose, and Hunt were invited to be present at the examination. The result of the investigation by these gentlemen confirmed me in the opinion that the elephant was indeed pregnant, rare as I knew such a phenomenon to be in a state of captivity. Indeed, it was questionable whether there had ever been such a case on record well authenticated. It is true that Prof. Owen states\* that two elephants paired Dec. 18, 1863, and that a young one was born Aug. 3, 1865, but it is not stated where the birth took place, nor is any author cited in reference to it. Admitting this case, on the authority of such a distinguished naturalist, it will be the only one, as far as I know, recorded up to this date. On questioning the intelligent keeper of the elephant, Mr. George Arstingstall, I learned that on May 25, 1878, the female in question had received the male, and that coitus had taken place on the 29th of the same month, and on the 3d, 8th, 13th, 15th, and 20th day of June. The latter day was that on which the last copulation took place, there having been seven in all. As various views have been expressed by naturalists as to the manner of connection, I will content myself with stating what I have seen and learned from the above-mentioned eyewitness, that the coitus is similar to that of bull and cow, or horse and mare, and that the time occupied is about the same period as in the horse. The penis when erect is curved, the concavity looking forward. When relaxed, the organ is curved in the opposite direction. Eight months having elapsed since the last coitus, it was natural that there should be some signs of pregnancy if fecundation had really taken place. The shape of the abdomen and the prominence of the mammæ, which are pectoral in position and are usually not very apparent, together with the fact that connection had taken place several times, were about the only

\* Anat. of Vert., vol. iii. p. 742.

facts I had for predicting the birth of the young elephant. Naturally, the question was at once asked, What is the period of gestation? Here again I was comparatively in the dark. In the *Thesaurus of Seba*, published in 1734,\* there is figured the fœtus of an elephant without any of the membranes, said to have been taken out of its mother at about the middle of the period of gestation. Zimmerman also gives a figure of a fœtus.† In the description of this fœtus only vague allusions are made to the length of gestation. As is well known, among the ancients, Pliny thought the period in the elephant was six months, Strabo about eighteen; according to Aristotle, however, nearly two years. What I had learned from travellers in the East, and from the case referred to by Prof. Owen, the time being in that instance 593 days, together with the fact of Aristotle‡ giving nearly two years, led me to indicate that about the 1st of March, 1880, would be the time at which the birth of the elephant might be looked for. The young elephant was born on March 9, 1880, at 2.30 A.M., exactly twenty months and twenty days after the last copulation, or twenty-one months and fifteen days reckoning from the first one, a longer period by thirty-seven or sixty-two days as compared with the case referred to by Prof. Owen. The fixing of the period of gestation 630 to 656 days in the elephant is another interesting illustration of modern investigation confirming the statements made by that most profound thinker and careful observer, Aristotle.

The labor was a very short one, the mother standing on all fours, with one hind foot slightly raised. The head presented, as observed by Mr. Porter. The umbilical cord broke, and was removed with the placenta and membranes shortly afterward by Mr. Arstingstall. Immediately after birth the mother rolled the young one in the straw. The young elephant, a female, stood 30 inches in height; measured, from base of trunk to root of tail, 35 inches; and weighed 213½ pounds. It was perfectly formed and well developed. It was noticed immediately that it sucked with the mouth, and not with the trunk, as Buffon reasoned it must do—an error so often repeated in works on Natural History. The young elephant spends most of its time sleeping, sucking, and walking about. The mother is extremely watchful, and restrains, by means of its trunk, the young one from getting out of its reach. When first consulted in reference to the supposed pregnancy, I impressed Mr. Arstingstall, who was then in charge, with the importance, if an elephant were born, of preserving any membranes that might come away during labor. I am indebted to his kindly interest, and to the liberality of

\* Fig. 111.

† Besch. eines Ungebornen Elephanten, Erlangen, 1783.

‡ De Generat. Animalium. Liber quartus, cap. 8.

Messrs. Cooper & Bailey, for placing the specimen at my disposal, and for affording me the opportunity of showing it to the members of the Academy. As far as I know, it is the only placenta in existence of an elephant delivered at full term. Prof. Owen received from Dr. Martin, of Ceylon, the placenta and membranes of an elephant supposed to have been born about the middle of gestation. This specimen was sent from India to London in arrack, and was described by Prof. Owen in 1857. It has been preserved since then in spirits, in the Royal College of Surgeons, in London, and was re-examined by Prof. Turner, of Edinburgh, the result of his investigation being given in his Lectures on the Comparative Anatomy of the Placenta.\* As will be seen from the following description, my specimen differs from that of Prof. Owen, but I think this difference is due, as might be expected, to the fact that one was delivered at full term, the other at only half that period.

As is well known, in certain animals, like the pig, cow, sheep, horse, etc., the chorion, or membrane which incloses the fœtus, comes away in labor without bringing with it any of the mucous membrane lining the uterus of the mother; hence, this kind of placenta is said to be noncaducous, nondeciduous, or noncoherent. The placenta in these animals is also said to be diffuse, as in the pig; or cotyledonary, as in the cow—according as the villous processes are diffused over the outer surface of the chorion, or are limited in the form of knots, bunches, or cotyledons. In man, monkeys, rats, bats, dogs, etc., during parturition, there is always cast off a greater or smaller portion of the mucous membrane of the mother; and the villous processes of the chorion of the fœtus insinuate themselves to such an extent into the mucous membrane of the uterus that the placenta in these animals consists of a fœtal and a maternal part; whereas, in the non-deciduous mammals the placenta consists simply of fœtal membranes. Hence, in man and the other animals last mentioned, the placenta is called coherent, or deciduous, or caducous. But just as the nondeciduous placenta exhibits itself under two forms, so we find the deciduous placenta either disk-shaped or zonular. The first kind is seen in the placenta of man, monkeys, etc.; the second in that of the dog and carnivora generally. Under what form of placenta does that of the elephant come? Without doubt the zonular, and to a certain extent, also, the diffuse, as Prof. Owen has asserted. Is it a deciduous or nondeciduous placenta? Prof. Turner has satisfied himself, from an examination of Prof. Owen's specimen, that it is deciduous.† The examination of the injected bloodvessels‡ in my speci-

\* *Comp. Anat. Placenta.* Edinburgh, 1876.

† *Op. cit.*, p. 101.

‡ Mr. Nash was good enough to inject the specimen for me, with perfect success. Otherwise it would have been difficult to distinguish the fœtal and maternal parts, so interlaced were they.

men leaves little doubt that at least one-fourth of the girdle-like placenta of the elephant consists of the hypertrophical mucous membranes of the uterus. It will be seen, therefore, that the placenta of the elephant is not only interesting on account of its rarity, but also from its combining the characters of the placenta of three different sets of animals. The impossibility of using the placenta, in the case of the elephant at least, as a means of classification is therefore sufficiently obvious. As the taxonomic value of the placenta in general has been well discussed by Home, Owen, Milne Edwards, Huxley, and others, I will not dwell further on that part of the subject, but proceed to describe the specimen before me.

The chorion (Pl. 48, *a, a'*) of the elephant is an oblong whitish sac tapering rather into an obtuse end. Its length is five feet two and a half inches, width two feet four inches. The outer surface of the chorion is tolerably smooth and transparent. The inner surface exhibits a number of bloodvessels. The chorion is encircled or girdled by the placenta (Pl. 48, *c*). On each side of the placenta there is an indistinct brownish granular layer (Pl. 48, *x*) four inches in width and about a line thick, which runs parallel with the whole circumference of the placenta, and in some places even overlaps it slightly. This same granular matter was found even scattered over the surface of the placenta, and was easily rubbed off with the finger. Its microscopic structure reminded me of broken-down granular matter, and I suspect it may be maternal in its origin. At the two poles of the chorion I found the "subcircular vascular villous patches" (Pl. 48, *v*) described by Prof. Owen. The villi in this position were not more than a line long. The placenta entirely surrounds the chorion, but is situated at one side of the middle line. Consequently, the two parts of the chorion differ in length, the longer measuring thirty-five inches, the shorter twenty inches. The width of the placenta is seven and a half inches, making a total length in long diameter for the chorion of sixty-two and a half inches, as stated above. The circumference of the placenta is five feet one inch, and on an average it is two inches thick. The placenta preserves the same average width all round; there is no constriction dividing it into the "two moities" described by Prof. Owen; and another difference is that the villous processes are as well developed at the edges of the placenta as in the middle. Indeed, there is no smooth surface whatever, as seen in Prof. Owen's specimen. The general appearance of the placenta was that of a brownish spongy zone. After injection, however, when the vessels had been filled, the red color differentiated very well the fetal from the maternal parts, which were closely interlaced. The villi divided and subdivided in an arborescent manner,

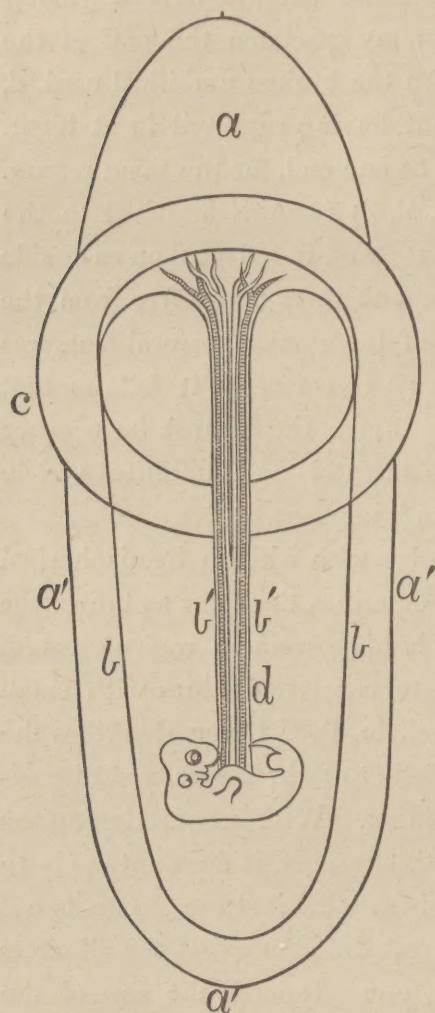
and were coarse in structure. Some passed through the whole depth of the placenta; others a half and third of that length. The terminal branches of the vessel could be readily followed in them, dividing and subdividing in the same manner, and ending in loops. It will be seen, therefore, that the chorion is principally attached to the uterus by means of the girdle-like placenta, but probably to a small extent also by the villous patches, seen at each pole. These patches have a greater morphological than physiological significance. In my specimen the end of the smaller sac of the chorion (Pl. 48, *a'*) is open, with the broken umbilical cord, *d*, protruding, evidently owing to the young elephant having ruptured it at birth. The amnion (Pl. 48, *b, b*) necessarily is also broken at one end, for the same reason. A considerable portion of this membrane (Pl. 48, *b', b'*) remains attached to the umbilical cord and to the foetal surface of the placenta, and is reflected on each side to the foetal surface of the chorion for two inches, and then hangs free from the chorion to an extent of twelve inches. The rest of the amnion, several feet, was preserved separately. If I have described these parts correctly, it follows that when the foetus is in utero, and the membranes intact, there must be a space between the amnion and the chorion in which the allantois and umbilical vesicle will be found. To these structures I will return in a moment.

The inner surface of the amnion is studded over with whitish hemispherical bodies about one line in diameter. Prof. Owen describes the color as brownish; the difference may be due to the spirit in which his specimen was preserved. Under the microscope\* these granules appeared to consist of fibres with small bodies interspersed. In the paper already referred to, Prof. Owen describes the mucous or unvascular part of the allantois as consisting of three sacs, and disposition of these sacs in reference to the chorion and amnion. Without questioning the correctness of the description of his specimen in this respect, it does not apply to mine, there being no evidence here of any allantois as a distinct sac. This is not surprising, however, when one considers the very great difference that the allantois exhibits in animals, as regards size, permanency, etc. Indeed, the size of the allantois varies to such an extent that Prof. Milne Edwards gives a classification based upon this difference, calling the divisions Megallantoids, Mesallantoids, and Microallantoids respectively. The allantois may remain as a simple sac so undeveloped as never to fuse with the chorion, as I have recently seen it in a foetal kangaroo in utero;† or, after having fused with or replaced the chorion, it may

\* I am indebted to Dr. Morris Longstreth for kindly examining some of the structures, and for confirming what I learned from my own observation.

† The first instance of this kind was described by Prof. Owen.

entirely disappear as a distinct sac, as in man. Between these extremes there are a number of intermediate stages exhibited in mammals. Remembering, then, that the permanency of the allantois as a distinct sac is very variable, but admitting that at some period of gestation it is present in the elephant, it is incumbent upon me to endeavor to explain what became of it in my specimen. As is well known,



*a.* Chorion, large pouch. *a'.* Chorion, small pouch. *b, b'.* Amnion. *d.* Umbilical cord. *c.* Placenta.

the allantois is a diverticulum of the posterior part of the alimentary canal, and as this canal is developed out of the hypoblast and part of the mesoblast, necessarily the allantois will consist of the same two layers, or darmdrusenblatt and darmfaserblatt of the German embryologists. The allantois expands into the amnio-chorionic space, and gradually reaches the chorion. Its outer layer, the mesoblastic part, the darmfaserblatt, or the vascular or exochorionic portion, replaces or fuses with the chorion, and is the layer in which the foetal vessels are found. It is this layer which forms the foetal portion of the placenta in my specimen. The inner layer of the allantoic sac, which is a continuation of the epithelial layer of the alimentary canal, the hypoblastic part, the darmdrusenblatt, the mucous or endochorionic layer, is, however, non-vascular. Now suppose that the outer part of this layer adheres to the vascular layer as the vascular layer adheres to the chorion, and the three membranes fuse their identity into one. All trace, then, of the mucous unvascular endochorionic part of the allantois will have disappeared as a distinct membrane, as is the case in the human being. On the other hand, if the

inner part of the mucous and vascular layers, which lie against the amnion, should fuse with it, then that part of the mucous layer of the allantois would also disappear in the course of development. Such a mode of disappearance of the allantois seems to have taken place in the development of the membrane of my specimen. For, on carefully examining the amnion, I find that in a greater part of its extent it can be separated into two layers, the

outer of which seems to represent part of the allantois. On the other hand, while it is impossible to distinguish the chorionic layers, nevertheless it will be seen that the branches of the umbilical arteries and veins lie upon the inner or foetal surface of the chorion, and that they pass over the chorionic surface of the cotyledons. Now, Prof. Owen states that in his specimen these cotyledons (Pl. 49, *z, z, z*) adhered to the "allantoic side of the sheath of the vessel," and that "the cotyledons belonged entirely to the latter membrane;" that is, the allantois, after this had been removed from the chorion. This confirms what an examination of my specimen led me to suppose, namely, that the vessels and cotyledons lie between two layers: the outer one, the chorion and vascular layer of the allantois; the inner, the mucous layer of the allantois—all three being fused into one in my specimen. If this view be correct, the elephant in utero would be inclosed, first by the amnion—then there would be a space; and, secondly and externally, by the chorion. The allantois would exist only as a distinct sac in the earlier periods of pregnancy. The same will hold true of the umbilical vesicle, of which I did not find a trace. Prof. Owen tells us that he counted one hundred and twenty cotyledons in his specimens. There are over two hundred and fifty in mine, varying from half an inch to over an inch in length.\* I noticed about a dozen in the amnion, which also confirms the view offered of its having two layers. These bodies seem to be fibrous in structure, with some inter-fibrous granular matters. As to their morphological or physiological import I have nothing to offer.

The umbilical cord is three inches in diameter and fifteen inches in length, measured from beginning of umbilical vein to where it divides into two branches (Pl. 48, *d*). It consists of two arteries and one large vein, held together by the usual connecting tissue (Pl. 48, *d*). The main vein divides into two, which attain a length of about twenty-two inches before reaching the outer border of the placenta (Pl. 49, *d, d'''*). The outside artery, double the size of the innermost one, divides into two branches, which accompany the branches of the vein to the outside of the placenta (Pl. 49, *d, d'''*). The umbilical vein, ten inches above its bifurcation, gives off a slender branch (Pl. 49, *d', d''*), which bifurcates six inches below its origin, and passes to the middle parts of the placenta. The small umbilical artery divides into two branches, which accompany the small umbilical veins to middle of placenta (Pl. 49, *d', d''*). There are, therefore, two large and two small main arteries, and two large and two small main veins. The manner in which these vessels are situated in the placenta is sufficiently apparent from the figures.

\* I find them usually in the vicinity of the placenta and along the course of the longest vessel.

## GENERATIVE APPARATUS.

The female generative apparatus of the Indian elephant is described by Hunter,\* Mayer,† and Miall and Greenwood.‡ That of the African elephant by Perrault§ and Forbes.|| Having had the opportunity of examining the generative apparatus of the African elephant, which died at the Philadelphia Zoological Garden last July, and being at that time unacquainted with Mr. Forbes' description, which was read to the London Zoological Society, April 23d, I took several measurements on the spot, and having preserved the specimen in spirits, it occurred to me that it would be interesting to supplement the description of the placenta with that of the generative organs. It is true that the placenta is of one species and the organs of another; but the difference in the sexual organs of the Indian and African elephants is so slight that the description of the one serves very well for that of the other. I state this not only from the observations of the anatomists cited above, but from an examination I made in August, 1874, of an Indian elephant known to be over one hundred years old, which also died at the Zoological Garden. The alimentary apparatus was shown at one of the meetings of the Academy, and described. The cause of death in that case was cancer of the uterus and urogenital canal; and disease had so obscured the parts that I did not venture to interpret them at that time. On comparing the structures with the healthy ones of the African elephant I am satisfied that they agreed in all essential respects.

In the African elephant, which was about half grown, I found the vulva situated two feet anteriorly from the anus. It led into a passage that I believe should be called the urogenital canal, inasmuch as it serves to transmit the generative products and the urine (Pl. 50, *i*). This canal measured 36 inches in length and 28 inches in circumference, and was lined with a mucous membrane exhibiting rugæ. Just within the vulva the glans of the clitoris was quite apparent with its prepuce (Pl. 50, *m*). The clitoris measured 15 inches. The crura are attached to the rami of the pubis¶ (Pl. 50, *l*). At the upper end of the urogenital canal may be seen together three openings, the middle one large enough to admit only one's finger (Pl. 50, *g*), leading into what seems to be homologous with the vagina;

\* Essays, edited by Prof. Owen. London, 1861.

† Nova Acta, vol. 22, 1847.

‡ Journal of Anatomy and Physiology, 1879, vol. 13.

§ Mem. de l'Acad. des Sciences, tom. iii., 1734.

|| Proceedings of Zoological Society, 1879.

¶ I noticed also the muscles corresponding to the levatores penis in the male.

the two smaller ones on either side of the vaginal opening are the sinuses of Malpighi. These three openings can be completely shut off from the urogenital canal by a valvular fold of mucous membrane, of a somewhat semilunar shape, about  $2\frac{1}{2}$  inches in breadth (Pl. 50, *h*). The effect of this fold seems to be to prevent the flow of the urine into the vagina; as the urogenital canal *in situ* is so situated that this would be apt to take place, the canal being curved and the posterior part of the curve being lower than the anterior. Below this valvular fold is seen the opening of the bladder into the urogenital canal. The circumference of the bladder measures 18 inches. The vagina, the cavity into which the urogenital canal opens, is 14 inches in length, and 6 inches in circumference (Pl. 50, *f*). The mucous membrane is lined with longitudinal folds. The vagina opens into a cavity which seems to be the uterus\* (Pl. 50, *d*). The uterus can be entirely occluded from the vagina by a fold of mucous membrane. This fold (Pl. 50, *e*), which is vaginal, measures about  $1\frac{1}{2}$  inch, and is of semilunar form, but indented in the middle. The opening of the vagina into the uterus is about twice as large as that of the vagina into the urogenital canal. The length of the uterus was 7 inches; its diameter, 5 inches. Its mucous membrane, thrown into longitudinal plaited folds, was similar to that lining the cornua. The two cornua opened by distinct passages into the body of the uterus, and were 30 inches in length, and measured nearly three inches in circumference (Pl. 50, *c*). The Fallopian tubes—passing rather into the side of the cornua, about two inches in length, and with a diameter of about one-eighth of an inch—expanded into the trumpet-shaped fimbriated extremity (Pl. 50, fig. 2). The fringes of the pavilion were long, slender, and tassel-like. The peritoneal fold supporting and surrounding the pavilion was also fringed. There is a distinct fold of peritoneum separating the pavilion from the ovary (Pl. 50, fig. 2). The ovary and pavilion can be entirely inclosed by the pouch of peritoneum attached to them (*p*). The right ovary, in largest diameter, measured  $2\frac{1}{2}$  inches; the left, 2 inches. On cutting into the ovary, I did not find very many Graafian follicles. I found, however, the ovum in one of them, which, under the ordinary powers of the microscope, did not exhibit any character different from that of the mammalia generally, the zona pellucida, germinal vesicle and spot being all identified. It will be noticed, on referring to Miall, Greenwood, and Owen, that their description of the Indian elephant is essentially the same as that of the African species I have just given. According to Mayer, however, in the Indian, and to Perrault in the African species,

\* What I have called vagina may really be an elongated cervix uteri.

there is no distinction between what I have called uterus and vagina, there being but a single chamber between the cornua and what I have called the urogenital sinus, which Mayer\* considers vagina, "Die mit der urethra vereigte vagina". I have mentioned only incidentally up to this time Mr. Forbes's valuable paper, as I preferred giving my description as I noted the structures in last July. Of course his paper has priority; but it is a satisfaction to me that I came independently to the same conclusions as Mr. Forbes without a knowledge of his dissections.

It appears to me that there can be little doubt now that the generative organs in both species of elephants are understood. It is true that at first sight the uterus appears to be a small chamber to hold a baby elephant; yet, when the size of a human baby is considered in reference to the womb holding it, the ratio will be seen to be rather in favor of the elephant. It would certainly be inferred, from the size of the urogenital sinus, that the labor would be easier in the elephantine than in the human female, as was seen to be the case. Nevertheless, it would be a satisfaction to see an elephant in utero, with the membranes intact, so that the morphology and physiology of the parts might be determined beyond cavil by a philosophical physiologist. For, inasmuch as the uterus and vagina are formed through the coalescence of the Müllerian ducts, it is impossible *a priori* to say how much of the duct would become uterus and how much vagina.

\* Op. cit., p. 38.

## EXPLANATION OF PLATES.

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### PLATE XLVIII. PLACENTA AND MEMBRANES.

Fig. 1. *a.* Chorion, large pouch. *a'.* Chorion, small pouch. *c.* Placenta. *d.* Umbilical cord. *v.* Sub-circular vascular villous patches. *x.* Brownish granular layer.

Fig. 2. *a.* Chorion, large pouch. *a'.* Chorion, small pouch under surface. *b, b'.* Amnion. *d.* Umbilical cord. *c.* Placenta.

### PLATE XLIX. PLACENTA.

*d, d', d'', d'''.* Arteries and veins of umbilical cord—distributed through membrane and bearing cotyledons, *z.*

### PLATE L. GENERATIVE APPARATUS. SEEN FROM BEHIND, POSTERIOR WALL SLIT UP IN MEDIAN LINE.

Fig. 1. *a.* Ovary. *b.* Fallopian tube. *c.* Cornua uteri. *d.* Corpus uteri. *e.* Valve. *f.* Vagina. *g.* Aperture and sinuses of Malpighi situated in partition between vagina and urogenital canal. *h.* Valve protecting vaginal opening. *i.* Urogenital canal. *k.* Bladder. *l.* Clitoris seen through anterior wall of urogenital canal. *m.* Glans clitorides.

Fig. 2. *a.* Ovary. *b.* Fallopian tube with penetrated extremity. *p.* Edge of fold of peritoneum separating ovary from penetrated extremity.

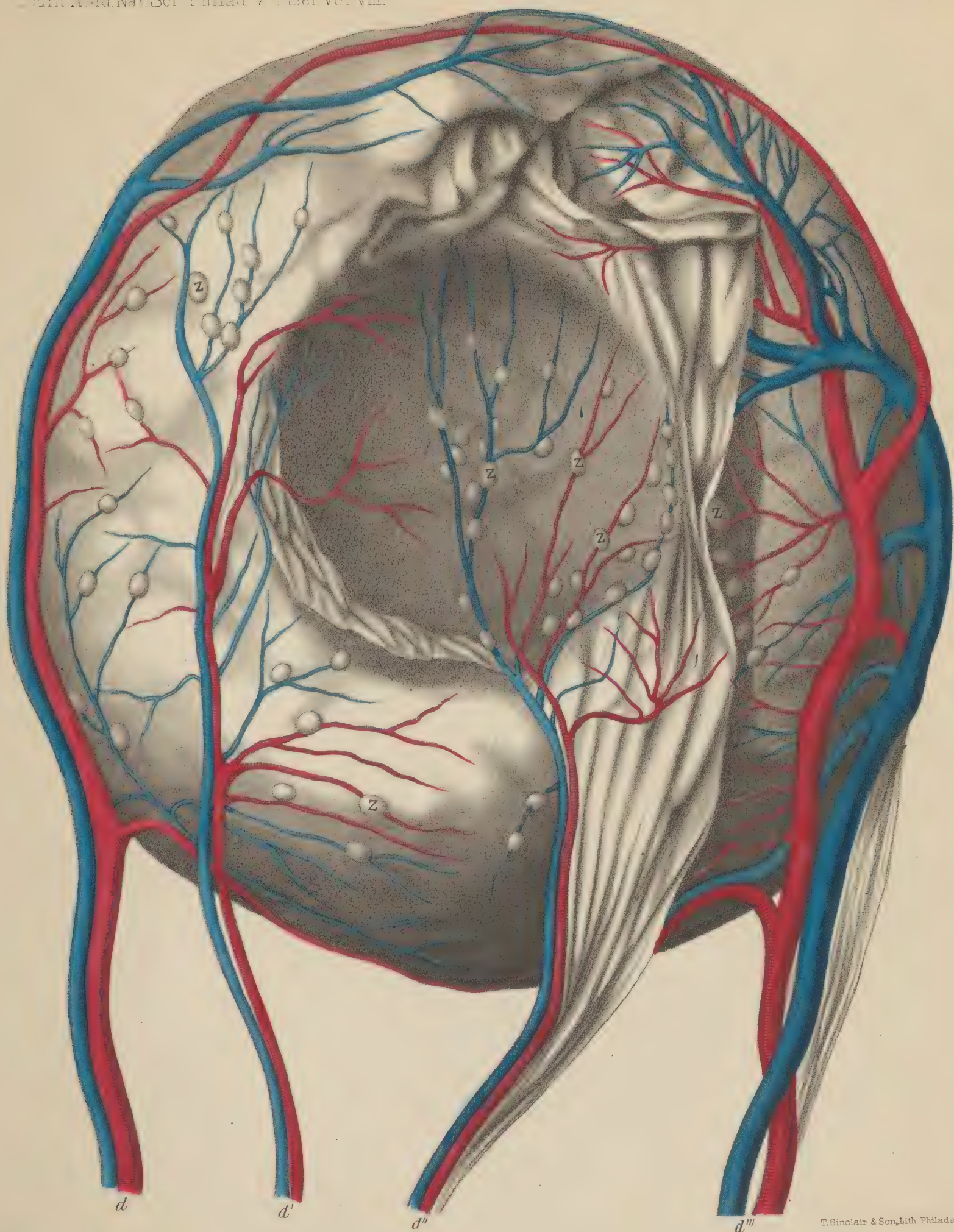




T. Sinclair & Son, Lith Philada

Chapman on Placenta of the Elephant.





T. Sinclair & Son, Lith. Philada

Chapman on Placenta of the Elephant.





Chapman, Generative Organs of Elephant

T. Sinclair & Son, Lith. Philada.





